ESTONIAN UNIVERSITY OF LIFE SCIENCES
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PERMAKULTUUR KUI VÕIMALUS VÄIKESTE PEREFARMIDE HEAOLU PARANDAMISEKS

PERMACULTURE, A WAY TO IMPROVE SMALL FAMILY FARMERS LIVELIHOOD IN RURAL AREAS?

Master's thesis
Curriculum in Agri-Food Business Management

Supervisor: Raul Omel

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Small scale farming, in the entire world but particularly southern countries including Morocco, faces considerable uncertainties regarding income perceived, due to several factors including climate change, high costs of inputs, and low return on investment, impacting considerably the families livelihoods in rural areas. The object of this research is to figure out if permaculture could actually improve the livelihood of smallholder farmers in an international context, with the case of Morocco as an example. The method applied to this research is based on the reading and analysis of secondary data from research papers to governmental reports, but also through the development of a questionnaire shared among permaculturists from Morocco in order to bring elements that will support the outcome.

Keywords: Permaculture, conventional farming, agroecology, farming system development (FSD), farming system research (FSR),

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1. INTRODUCTION

Since the beginning of time, the ecosystem has always known to deploy itself in an autonomous and self-ruling manner in order to create a self-sufficient habitat respectful to ecology, and balancing life between plants, animals, humans, and the environment. That said, with a world population growing at a rate of around 1.05% per year, a current average population estimated to be growing up to 81 million people per year (Data World Bank, 2020), and a world open on globalization with change in eating habits, the humankind found itself constraint to develop a very large pallet of agricultural technologies, from chemically based pesticides and fertilizers to heavy machinery in order to multiply crop yields so as to ensure food security.

Agricultural development isn't to be considered as a phenomenon leading straight towards ecological collapse if the latter is built around a harmonious and balanced interplay between protecting the ecology, generating a viable economy (Hayami & Ruttan, 1971), and responsibly putting biophysical into usage (Henao & Bernaante, 1999). In fact, it is a necessity that should constantly be looked upon to fight dangers, such as climate change, soil depletion, malnutrition and poverty (Henao & Bernaante, 1999) encompassing food security all over the world. Agricultural development is a powerful tool to fight poverty and improve wealth (World Bank, 2020), especially among smallholder farmers and working farmers, because they are the first in line to be impacted by the general agricultural aggregates including tariffs, price inflation, policies and new technologies (Batt, 2015). Being the principal source of our food, agriculture employs approximately half of the world population, from which 95 % live in the global South and nearly half are women (Pimbert 2009).

In Morocco, agriculture remains a fundamental component of the economy, with a Utilised Agricultural Area (UAA) of around 9 million hectares, including a cultivated area of nearly 80%,

the agricultural sector is a key factor in Morocco's economic and social development (Houzir, 2016). In addition, agriculture contributes 14 to 15% of the national GDP (IndexMundi, 2020) with an average production of 100 billion dirhams since 2009 of which nearly 25% is exported and employs nearly 43% of the working population (Houzir, 2016). The agro-industry with its 2050 companies represents in Morocco nearly 26% of the total of industrial establishments in the country, making it a strategic sector worth around 7.5 billion euros and providing 108,000 jobs (Sajid, 2018). However, about three quarters of poor people in the Moroccan territory live in rural areas (IFAD, 2019), while agriculture accounts for three-quarters of employment in those areas (Taqeem Initiative International Labour Office, 2019), which amounts to saying that farming is probably the most fragile job industry exposed to poverty, especially when it is in regard with traditional or non-intensive agriculture.

Small scale farming, in the entire world but particularly southern countries including Morocco, faces considerable uncertainties regarding income perceived, due to several factors including climate change, high costs of inputs, and low return on investment, impacting considerably the families livelihoods in rural areas. This phenomenon urges a transition to sustainable agricultural systems (Didarali et al., 2019) in order to improve social and economic equity, and the conservation of biodiversity and ecosystem (Wang, 2013).

In agriculture, farmers use a lot of chemical fertilizers and pesticides. These damage the soil structure and have also had damaging effects on toxicity, pollution of the environment, air and water. The development of sustainable agriculture is a very important process, it is a concept that is defined as follows: “Agriculture sustainable can be defined by the application to agriculture of the principles of sustainable development. It is therefore a question of promoting economically viable agriculture, socially responsible and ecologically sound.” (Kafadaoff, 2008). Bill Mollison, father of permaculture, a branch of agroecology, defined permaculture as: “The conscious design and maintenance of agriculturally productive systems which have the diversity, stability, and resilience of natural ecosystems. It is the harmonious integration of the landscape with people providing their food, energy, shelter and other material and non-material needs in a sustainable way.” In other words, “permaculture is a design system that uses ecological management practices and locally adaptive solutions for sustainability in all aspects of human endeavour. Such practices aim to optimise the interactions in the soil-plant system for an efficient use of their ecological

functions and ecosystem services, while promoting diverse, resilient, and regenerative agricultural systems" (Didarali et al., 2019). Following the meaning of this agricultural practice, permaculture could eventually present itself as a plausible approach that could improve the livelihoods of small family farmers through the minimization of cost of inputs. Literature reviews available on permaculture mainly highlight the positive impacts of permaculture on the environment and food nutrients, however, the impacts of permaculture on smallholder productivity and income have rarely been examined in empirical studies. This lack of unified, accurate and reliable information regarding the scope of income generated from a permaculture system might subsist from the fact that researchers have concluded the weakness of this last to provide a lifestyle that exceeds a "fair" level, or even reach this "suitable" livelihood where primary needs are the main highlights.

Agroecology, the mother branch of permaculture, is at the same time a science and a set of practices, based on two scientific disciplines: agronomy and ecology (De Schutter, 2010). The fundamental principles of agroecology involve recycling nutrients and energy directly on the land, combining crops and livestock, diversifying species, and concentrating on interactions and productivity across the agricultural system (De Schutter, 2010). The Food and Agriculture Organization of the United Nations (FAO) considers the social dimension also as a fundamental principle of agroecology, positioning the human and social values as factors defining culture and food traditions as well as actors in the process of co-creation and sharing of knowledge, and vice versa. The Figure 1 illustrates this interaction and interconnection between the different principles of agroecology. Human and social values can present itself as a predominant principle in a way that the adoption and approval of any decision, in this case the implementation of permaculture, depends on the level of acceptance of these last.

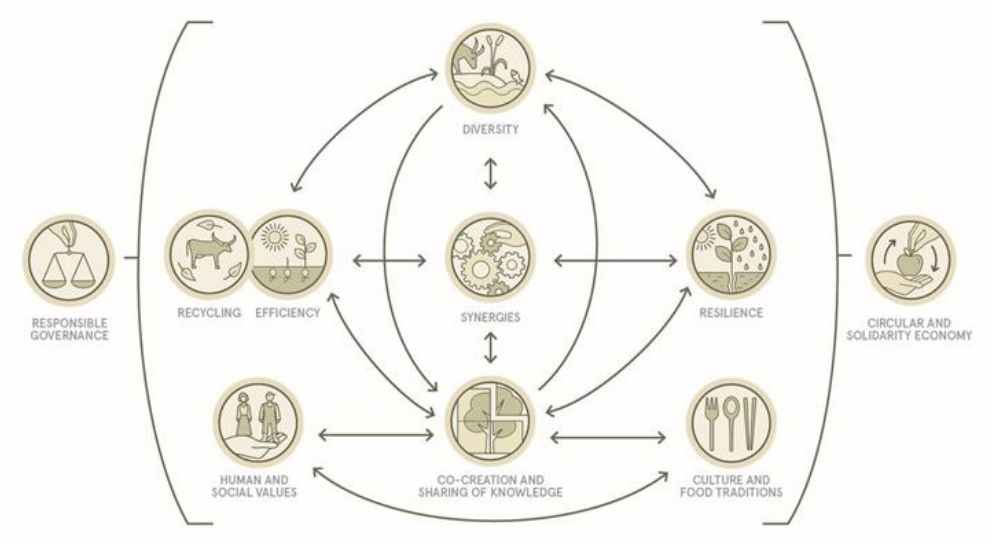


Figure 1. Interaction of the 10 elements of agroecology (FAO, s.a).

Geoff Lawton, an Australian permaculture professor, stated that "all the world's problems can be solved in a garden" (Ferguson and Lovell 201, as cited in Hathaway 2015). Evidently, this statement can involve a certain hyperbole, but the truth to keep in mind is that the permaculture model tackle the different problematics generated by industrial agriculture: "water and energy usage, climate change, and pollution by toxic chemicals, as well as social problems such as poverty and hunger" and offer efficient solutions to it (Hathaway, 2015).

The aim of this research is to examine the effect of permaculture, especially in the Moroccan environment, in improving rural livelihoods, while still using case studies based on the southern part of the world in order to draw a broader picture. In order to achieve this broad objective, we will need to set specific objectives to be able to draw a conclusion from a holistic approach to an empirical analysis:

- ➔ Objective 1: Understanding the paradigm of permaculture
- ➔ Objective 2: Examining the effect of permaculture on farmers revenue and income
- ➔ Objective 3: Determining the flow pattern of permaculture in Morocco
- ➔ Objective 4: Evaluate whether the short-term evolution the permaculture system is sufficient to bring small family producers to consider it as an economically attractive opportunity

In order to reach the above objectives, the research questions encompass two foundations, firstly the theoretical aspect and secondly the empirical aspect.

- **Theoretical**
  - ➔ What characterizes conventional farming and permaculture?
  - ➔ How is the choice of farming system made?
    - ◆ What determines what kind of technology should be chosen?
  - ➔ What is sustainable farming and how permaculture fits into this concept?
    - ◆ What is the paradigm of permaculture and what are the principles on which permaculture is based on?
    - ◆ How does permaculture work as a farming system?
- **Empirical**
  - ➔ What is the evolution of the agricultural sector in Morocco?
  - ➔ How is the Moroccan agricultural system?
  - ➔ What are the principal types of agricultural cultures in Morocco?

2. METHODS AND DATA

The methodology used to do this research relates firstly to the collection of primary and secondary data. The first goal was to assess the socio-economic background and the problems ensuing from the worldwide agricultural situation as well as the Moroccan context, which was set through the search and analysis of secondary data derived from government departments, organizational records and data that was originally collected for other research purposes. The second objective of this thesis is to try to define and explain with clarity the notions of conventional agriculture, permaculture, and the outcomes from the association of permaculture and smallholder farmers' livelihoods, in order to familiarize the reader on the fundamental concepts of this research and be able to build its own opinion on the subject. Thereby, the first step of the process was to collect articles, research papers, official documents and reports, allowing the understanding of the different attributes of the topic but also to build a pedestal for the next step, but also to select the passages deemed essential, to interpret them and to connect them with other authors' approaches. The following step concerns the collection of primary data through the conducting of a questionnaire on Google Forms, distributed on the Facebook platform in the group page called "Permaculture Maroc (Morocco)" and other groups on conventional farming in Morocco, to target both types of farmers. Comes after the process of collection, the step of data mining which will be sustained by the following approach: Exploration, Analysis, Interpretation, and Exploitation. The analysis of the results from the survey questionnaire will be treated with the support of Google Forms Analytics in order to come up with a descriptive analysis in terms of qualitative approach and quantitative approach. The household can also be the unit from which information on costs and returns is collected, even if the means of survey used in this case needed to be adapted to this specific objective. This may be relevant especially in developing countries where family farming is widespread and where farm income represents a significant share of household income. Collecting data at the household level allows the compilation of indicators that measure household

livelihoods and other variables, such as size and location, and other household variables that may have an interest with this analysis.

In this research, the role of the quantitative method will only consist in calculating the percentages and the frequencies of certain traits or attributes, such as the frequency of smallholder's permaculture farmers traveling abroad or locally over a given period, the number of farmers owning a smartphone for instance (as an object not belonging to basic necessities), or the number of members in a smallholder family farmer. In other words, "quantitative methods are methods of researching numbers or anything quantifiable (Bellaing Louis, 1994). The quantitative method allows us to quantify the results to facilitate treatment and draw a conclusion. This can be explained by calculating the propositions, frequencies and percentages.

It is necessary to indicate that quantitative and qualitative analysis are complementary. The use of quantitative methods makes it possible to express with precision and to make verifiable qualitative ideas. While the use of qualitative methods is to interpret the numbers provided by quantitative methods.

The survey questionnaire was developed in a way to come up with a data classification that highlights the general illustration of the participant (e.g. gender, property size, age etc), his or her socioeconomic background, and the cost and income generated by his or her agricultural activity (permaculture farming) with a focus on cost of inputs, especially in terms of fertilizer usage and pesticides and herbicides. The survey is shared on the Facebook group page "Permaculture Maroc" in order to reach out a maximum of participants from the permaculture farming.

3. LITERATURE REVIEW

3.1. Assessment of conventional farming

3.1.1. Definition of conventional agriculture

Called modern or conventional agriculture is the result of the integration of science, technology and practice in a determined historical context in currently industrialized countries; the processes of industrialization and urbanization therefore required accelerated increases in productivity, in the agricultural sector in order to satisfy, at low prices, the growing demand for food products of the population, in this situation has occurred the transition from traditional agriculture (low physical productivity) to what is called conventional agriculture (Cary and Moony, 1990). In other words, conventional farming is defined "as that which uses synthetic fertilizers, pesticides, and a heavy reliance on tillage" (Reginald et al., 1987; Gomiero et al., 201; as cited in Nessly, 2015). Nowadays, this type of farming continues to be the dominant method of production even though the consequences of this system generate considerable constraints in "diminished soil quality, affecting the soil's ability to continue to produce food" (Reginald et al., 1987; Gomiero et al., 2011; as cited in Nessly, 2015.)

3.2. Characterization of conventional agriculture

Since its genesis, conventional agriculture has been born marked by the productivism character, due to the fact that it is required to significantly increase its productivity. in terms of product per unit of land used or unit of labor employed, this means that agricultural activity is immersed in an intensification process through the increasing use of inputs (compound feed, crossing of selected varieties, fertilizers, pesticides...), an equally increasing specialization and homogenization (collapsing the genetic variety) (Jiménez, 1989). This has been technically possible thanks to research which has been geared towards the goal of increasing productivity. In addition, agriculture as an economic activity has been subject to pressure from a certain type of and therefore motivated to raise productivity (Murua et al., 1995). With the passage of time and the prolonged practice of this model of farmers the limitations begin to reveal themselves in the sense that they begin to manifest degradation effects produced in the physical environment as a consequence of excessively intensive practices and mismanagement. resources (salinization, erosion, contamination, overgrazing, desertification, etc.) (Murua et al., 1995).

Irrigation as well as fertilizers are the most efficient processes for achieving rapid increases in agricultural productivity. However, there is evidence to indicate that inadequate irrigation systems lead to soil salinization (Kafadaroff & Douce, 2008). The intensive use of chemical fertilizers causes long-term loss of organic matter in the soils. The intensive use of agro-chemical products (pesticides, herbicides, etc.) contributes to increasing productivity, but at the risk of creating problems with regard to the environment and even human health (Kafadaroff & Douce, 2008).

3.2.1. The advantages of conventional agriculture

The practice of intensive agriculture is advantageous on several levels. On the agronomic level, intensive agriculture makes it possible to considerably increase agricultural production in terms of

both quantity and quality. In France, for example, it has significantly increased agricultural productivity, going from 2 to 10 tones per hectare. It can help produce sufficient quantities of food to fight hunger in the world. The large input of fertilizers that intensive agriculture requires can prevent the loss of natural soil fertility (Mariel G, et al., 2014). On the economic plan, the use of intensive agriculture allows the producer to improve his income because this technique significantly increases the yield. Reducing the labor force required for agricultural work is another economic advantage for the producer (Mariel Gume et al., 2014).

3.2.2. The disadvantages of conventional agriculture

For more simplicity, the price to pay is heavy. Monoculture and plowing over very large areas lead to a massive decrease in biodiversity. Soil erosion is worrying. Mechanization, ever more important, to exploit larger areas, requires heavy investments (Prud'homme, et al., 2019). The farmers are getting into debt. Mechanization and inputs impose high production costs which often remove any economic profitability from farms. As a result, governments continue to subsidize conventional agriculture, even after the Green Revolution. Because, without subsidies and numerous low-rate bank loans, this method could not be profitable. For example, agricultural diesel remains taxed much less so as not to slow down the use of agricultural machinery (Prud'homme, et al., 2019). In the context of conventional agriculture, a slowdown would lead to less efficient exploitation, and therefore tend towards less yield (Prud'homme, et al., 2019).

3.3. The concept of permaculture

3.3.1. Definition of permaculture

Permaculture's approach is focused on sustainable agricultural ecosystems. It's an international grassroots network, both in rural and urban areas although it was initially developed in a rural setting. The key principle is that humans can reduce or replace pollutive industrial technologies, mainly in agriculture, by the use of biological resources and thoughtful, holistic, design, patterned after natural ecosystems (eco-mimicry). Despite the high attention by the general public, permaculture has received little scholarly attention. Its concept has been evolving and varies among sources over time. According to "Holmgren and Mollison", permaculture's originators define it as "an integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man" (1978). By 2002, Holmgren defined permaculture more broadly, incorporating broader issues of human settlement while maintaining its primary agricultural focus: "Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fiber and energy for provision of local needs" (Holmgren, 2002).

3.3.2. Principles of permaculture

Permaculture is one of the solutions to be considered in order to move towards sustainable, equitable and sustainable agriculture from a social, economic and environmental point of view. Through simple and economical agricultural practices, it can renew the symbiotic links that united, not so long ago, the farmer and his land. David Holmgren, as the founding father of the permaculture movement, spelled out 10 essential design principles (Holmgren, 1999):

1) **Observe and interact:** Permaculture is seen as the agricultural practice mimicking the ecosystem but also what farmer neighbors have been growing for centuries because they possess experimental knowledge.
2) **Catch and store energy:** The idea is to collect these renewable energies, immediately available and local in order to redistribute them when they become scarce (principle of preserving seasonal surplus).
3) **Obtain a yield:** The priority is to cultivate plants that ensure sufficient harvests both in the short term and in the long term, meeting our immediate needs and our expectations in terms of both quality and quantity.
4) **Apply self-regulation and accept feedback-** As for any agro ecological system, the need for self-regulation or self-control is fundamental. If we are to guarantee a sustainable world and a stable future for future generations, an awareness of our dependence on nature and our individual responsibility is needed in order to trigger change.
5) **Use and value renewable resources and services and produce no waste:** Renewable resources and services are provided to us by the sun, wind, plants, animals, land, water, tides. A resource is considered renewable when it renews itself naturally over a humanly reasonable period of time. Permaculture tends to make the best possible use of these renewable natural resources and services rather than non-renewable ones in order to achieve a balance and ensure short, medium and also long-term production.
6) **Design from patterns to details**: Understanding general patterns and patterns present and functioning in nature inspires any permaculture conception. Landscapes and ecosystems, just like a cell in an organism, have nodes that concentrate energy and various functions. Thanks to their structure and organization, natural ecosystems benefit from a maximum of energy by providing a minimum of effort. These systems, especially forests, can serve as models for agriculture and agroforestry.
7) **Integrate rather than segregate and use and value diversity:** Polyculture is a system inspired by nature in the wild, where species naturally blend together to form an integrated system. Permaculture encourages cultures of different species brought together where symbiotic relationships take place and bring mutual benefits to all plants.

8) **Use small and slow solutions:** Permaculture encourages small and slow solutions since they are more practical and easy to use than bigger solutions. Also, they enable more sustainable outcomes.
9) **Use edges and value the marginal:** The borders provide the organizations present with the advantages of two border environments: they are dynamic and very productive areas with a significant exchange of materials and energy. It is also a place where cooperative relationships take hold between species. Therefore, extending an edge can be a very effective way to improve the productivity of a system.
10) **Creatively use and respond to change:** by carefully observing the inevitable changes that occur in nature and intervening at the right time, our impact can be positive.

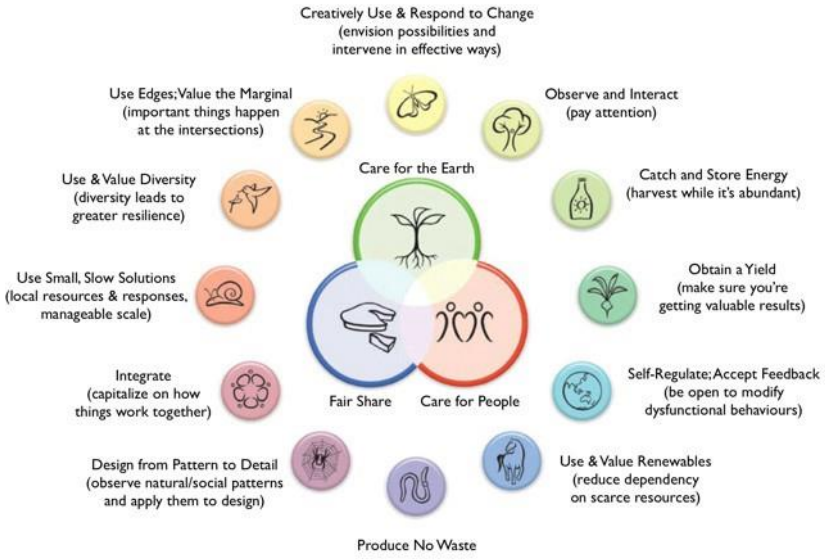


Figure 2: The 12 Principles of Permaculture as Rules of Living (David Holmgren, 1999)

3.3.2.1. Mound cultivation

Cultivation on mounds is a technique of permaculture. Originally, it was used by many people around the world to produce food, especially in Latin America, Africa, Australia and Asia (Krebs

& Bach, 2018). However, the choice of this method may only be effective depending on its context. Mound cultivation was democratized by Sepp Holzer, an Austrian farmer (Krebs & Bach, 2018). Mound is actually a generic term, which refers to a perennial mound of earth (Pinier, 2017. It allows the creation of a growing medium adapted to the contexts and objectives specific to each gardener (Pinier, 2017). There are several different typologies in terms of shapes, heights, borders and internal compositions (Krebs & Bach, 2018). Depending on their type, the mounds are made up of a stack of different layers of local organic materials: wooden planks or logs, stones, bricks, tree pruning residues, clippings, kitchen waste, etc. (Krebs & Bach, 2018)

The elevation of the earth allows, in certain contexts, to offer a multitude of advantages. By creating relief, we increase the cultivable area (Pinier, 2017). Another advantage is the elevation of the earth promotes drainage of rainwater and other stagnant water. This prevents saturation of the soil with water, which is harmful for most crops (root rot). However, cultivation on mounds is time consuming and requires energy to set up, and requires the strength of arms or mechanized machinery (Pinier, 2017). More exposed to wind and sun, a hill dries faster (especially in summer) and will therefore tend to sag over the months (Pinier, 2017).

3.3.2.2. Polyculture

Unlike the gigantic monocultures in industrial agriculture, nature has always ensured that each ecosystem is composed of a maximum of biodiversity (Ribotto, 2010). This biodiversity is essential to life itself, as it creates a balance that allows ecosystems to be resilient in the face of disturbances and significant changes (Ribotto, 2010). This is why, in order to have a healthy garden, one must imitate this principle by practicing what is called polyculture (Krebs & Bach, 2018). Polyculture simply consists of cultivating several plant or animal species in the same environment and at the same time (Krebs & Bach, 2018). The food forest is a very good example. One of the basic principles in permaculture is to “enhance biodiversity”. No matter your context,

whether you are a farmer, an organic market gardener or an amateur gardener with a large plot of several hectares or only a small vegetable garden (Ribotto, 2010). Polyculture is a universal technique that applies to all settings. Cultivating a high biodiversity also greatly reduces the risk of the presence of pest insects or diseases (Krebs & Bach, 2018). This is because an undesirable will find a large monoculture much more easily than it will be able to smell from afar and will spread there very quickly. Same principle, a disease will easily infect a monoculture where it can pass from plant to plant (Krebs & Bach, 2018).

In addition to the integration of various and mixed species, polyculture also involves placing several specimens of each species in different places and associating the families and varieties of vegetables that go well together allows to create a synergy between them (Smith, 2015). Some plants, like herbs, repel pests with the odors they give off (Smith, 2015). Others, like legumes, can supply nitrogen to their neighbors, a nutrient that is more difficult to access (Smith, 2015). Or quite simply, the tomato can shade the salad, which prefers freshness in hot weather (Smith, 2015).

3.4. Farming system process selection

“A system is a set of interrelated, interacting and interdependent elements acting together for a common purpose and capable of reacting as a whole to external stimuli” (Elemo, 2009), and is described to be unaffected by its own output (Elemo, 2009). In other words, all the components of a system are interconnected, making it defective if one component is treated by itself without recognizing what impact it has on other parts of the system (Pezres, 2010). For instance, pay attention to the way a body reacts after a toe gets stub: the whole body reacts differently depending on the body part in a way that eyes may water, voice might express a feeling of pain, and hands may try to rub the painful toe (Pezres, 2010). Therefore, a system is the connection of several components, each having its proper role and functioning while still being interdependent with one another. It cannot be feasible to improve a car just by trying to fix one wheel by making it rather

bigger than the rest (Pezres, 2010). If this is a commonsense notion, then it also applies to biological and agricultural systems. The table below presents the following theoretical foundation on permaculture that will be studied.

Table 1. Summary of theoretical foundations notions used as comprehension materials

Author	**Method**	**Data**	**Most important conclusion**
D.W. Norman et al. (1995)	Farming System Development (FSD) and Farming System Research (FSR)	Productivity & Total Factor Productivity (TFP)	Limited resource farmers (and farmers in general) have an active and fundamental role in agricultural development process and in implementation of farming system
Bill Mollison et David Holmgren	Fathers of Permaculture	General view	Permaculture consists of gradually exalting the beneficial effects that can be obtained from judicious associations of plants (various and numerous) and animals (quite diverse and numerous too): it teaches you to create a kind of "cultivated ecology. ", or semi-cultivation (trees and perennial plants are in the spotlight) perfectly adapted to local conditions, and which is stable and safe in use.

3.4.1. Farming system & farming system approach to development (FSD)

Farms are complex frameworks because of the several closely related activities due to the common use of the farm labor, land and capital (Smith, 2015). The analysis of farming systems between intensive and sustainable is important to the subject research; one sure thing that applies to both types of farming is the role of the farmer in taking decisions, indeed the farmer is at the center of decision making which is based on reaching set objectives as well as aspirations within the limits of accessible technologies (Smith, 2015). From a general perspective of the farming system, the farmer uses inputs in order to produce outputs based on the available natural resources and technologies (Pezres, 2010). Thereby, it is up to a combination of multiple factors, in regard to the physical, biological and socio-economic environment and in accordance with the household objectives, that the farmer will measure the framework for development and utilization of a particular farming system (Smith, 2015).

Farming system is this interconnection between soil, plants, animals, power, labor, capital as well as other several inputs controlled or influenced by the government operating at different levels, politically and socio-economic (Norman et al., 1995). Farming system depends heavily on effective and efficient resource management strategy to reach economic and sustained production in order to fulfill several requirements, mainly with regards to household livelihood while conserving resources and keeping a decent environmental quality (Norman et al., 1995).

According to D.W. Norman, F.D. Worman, J.D. Siebert and E. Modiakgotla, in their book “The farming systems approach to development and appropriate technology generation”, the farming systems approach to development (FSD) rests on two inter-connected foundations (Norman et al., 1995). The first component involved in the building of a farming framework is understanding the functioning of the farm-household as well as its environment in order to determine the restrictions that the household might confront (Norman et al., 1995). Eventually, by doing so, the farming system is thought in a way to provide solutions to the identified constraints, through a mechanism of experimentation until the appropriate solutions are justified (Norman et al., 1995). The second foundation of the FSD resides under the fact to share verified solutions to other farm households

confronting the same situations and issues (Norman et al., 1995). Actually, in the mid-1960's, there was very little interconnection between technical experimentation and social science, in other words, the link between implementing an FSD from an empirical process where tests are run and its relationship with social aspects, including human society and social relationship, was extremely weak.

After the unsuccessful experiments in areas with unfavorable environments as well as resource poor farmers, the Farming System Research (FSR) took another direction, one in which technical experiments and social science became interdependent. This evolution of practice brought understanding with regards to limited-resource farmers in those areas (Norman, 1993; as cited in Norman et al, 1995) about their way of operating their farms. First of all, one trait that was raised is the rationality of farmers behind their way of using technologies. For instance, until the early 1970's, there was barely any station-based support regarding mixed crops, however, researchers observed that farmers were capable of engaging in rational farming practices. In addition, it was also revealed from these experiments that farmers who didn't benefit from successful agricultural innovations are themselves already natural experimenters (Biggs and Clay 1981; as cited in Norman et al, 1995). As a matter of fact, farmers in unfavorable regions have acquired the skill over the centuries of deciding on which methods to use in a natural way, even when the practice itself is informal in nature, in other words, not formal to statistical analysis (Lightfoot et al, 1991; as cited in Norman et al, 1995).

From this point of reasoning and understanding of farmers' knowledge, within a context of poverty and a complex climate system for agricultural purposes, the researchers developed the concept of FSR approach so that the design of FSR frameworks could be more suitable and specific depending on farmers' situations in order to provide successful outcomes (Norman, 1993; as cited in Norman et al, 1995). Researchers reshaped the FSR approach in a way that farmers are considered and implicated in the agricultural technology development process, in order for them to adapt to the new technology in the long run, but not only, it also has a sense of capitalizing on farmers' knowledge and shared experiences (Norman, 1993; as cited in Norman et al, 1995). Therefore, the fundamental principle of the FSR approach was the active participation of farmers regarding the design of farming systems, especially regarding the identification of adequate techniques. Through this acknowledgment of farmers' usefulness concerning agricultural development, limited resource

farmers are recognized for their fundamental productive role in all the FSR stages, from “the selection, design, testing, and adoption of technologies” (Norman, 1993; as cited in Norman et al, 1995).

3.4.2. Determinants of farm system process between intensive farming and sustainable farming

Several studies have sought to identify determinants to adoption of sustainable farming or conventional farming. The main element to this decision-making rests on socio-economic factors including exogenous and endogenous factors. Most analyzes suggest that sustainable agriculture reduces the costs of agricultural equipment. No-tillage or minimum labor means that operators can use a smaller tractor and make fewer passes in the field. This also results in lower fuel and repair costs. However, this simplified view masks some complexities while still making a fair comparison. For example, some operators may view agroecology as a complement rather than a replacement for all of their current practices. If they change only partially for sustainable farming (for example in a few areas or over a few years), then their mechanized labor cost may increase as they now have to plan for two cultivation systems or simply use their existing equipment. To take such complexity into account, economists distinguish between short-term and long-term costs, the former assuming no adaptation of the existing equipment and the latter taking into account such an adaptation. A comparative between sustainable farming and conventional farming regarding workforce study in Wisconsin (Mueller et al., 1985) found that average short-term sustainable farming labor costs were approximately 7 percent higher than average long-term costs. The average short-term costs per hectare for sustainable farming were greater than for conventional tillage. However, after adjustment to capital, the costs of long-term sustainability fall below those of conventional tillage. As a result, the predominant factor that leads farmers to choose between conventional farming and sustainable farming is cost of production, including cost of pesticides, workforce, fertilizers and other inputs. For instance, in a sustainable farming system, higher

herbicide applications appear to offset lower equipment costs, particularly early in the adoption period and with no-tillage. In fact, herbicides replace the use of machines for weed control. Location specific factors are important as perennial weeds can present problems for sustainable farming.

While it is true that sustainable farming often conforms to what Pampel and van Es (1977) call an "environmentally beneficial practice" (ie, environmentally friendly and cost effective), this is not always the case. Particular location constraints can result in reduced yields; furthermore, institutional factors may favor alternative practices (Pampel et al., 1997). Thus, it is necessary to consider the specific conditions of the place to determine the financial attractiveness of the sustainable farming system. Even in cases where financial incentives may seem attractive, consideration of non-financial factors is necessary to understand the actual and potential uptake of sustainable farming. The figure 3 provides a schematic representation of some farming system determinants (Norman et al, 1982), in which is presented two factors, exogenous and endogenous, belonging to the socio-economic determinant.

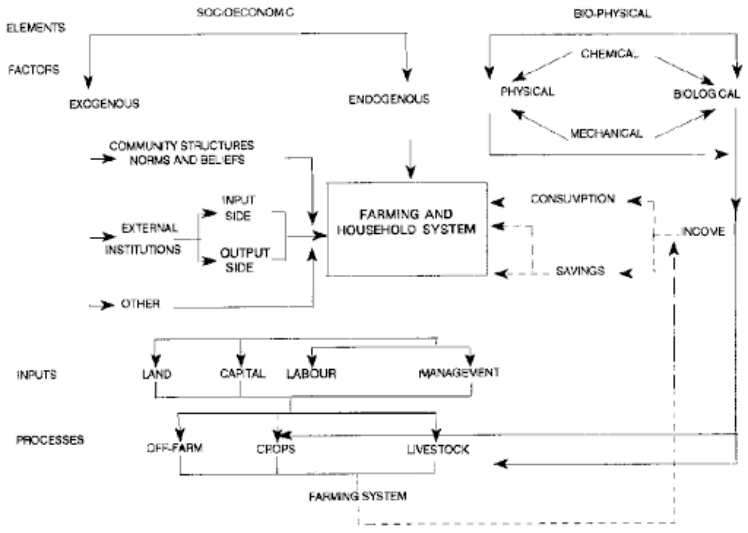


Figure 3. Schematic representation of some farming system determinants (Norman et al, 1982).

First of all, the endogenous human element is a factor influencing the type of farming system adopted in a specific region (Norman et al, 1982). When the farming system is based on

endogenous factors, the system is constructed in a way that family and means of livelihood are highly linked (Norman et al, 1982). The farm family's resources availability, including labours, land, capital and management, is under the family command (Norman et al, 1982). The quantity and quality of these listed resources are set based on the characteristics of the family, such as the family size and age, education and management skills, accessible labour, capital, objectives and attitude of the family (Norman et al, 1982). In addition, the exogenous human elements, comprise all the external social community structures, norms and beliefs, as well as external institutions, which rule over the allocation of available resources by the farmers (Norman et al, 1982). Farm producers also need incentives to be encouraged to convert their farming methods and production patterns into the desirable system (Snapp, 2017). Finally, another essential element to the decision making of farming systems relies on the biophysical aspect (Norman et al, 1982), in fact it represents the physical and biological elements which condition limitations to the type of agricultural system in a specific region (Norman et al, 1982). The physical elements include "land, soil quality, topography, climate, water, location, distance, etc." (Norman et al, 1982). Concerning the biological component, the following elements, crops and livestock physiology, diseases etc., determine the potential and opportunities of the farm (Norman et al, 1982). These biophysical components can be changed and adjusted "by limited intervention by the farmers and scientists" (Snapp, 2017). For example, production technology can be improved by scientists, and it will depend on the farmer to adopt it or not (Snapp, 2017). Another important characteristic of the farm is the productivity of its land. In a study realized by Noel. D Uri in 1997 (Snapp, 2017) shows that, in the United States of America, adoption of sustainable farming is more likely on farms with low levels of soil productivity rather than with higher.

3.5. Sustainable farming and permaculture

The economy is more and more developed; it consumes more natural resources and produces a large amount of waste, which has serious effects on the environment of human life, consequences

of non-respect and non-protection of natural assets (Kafadaoff & Douce, 2008). Nature is seriously affected, environmental pollution is widespread, concentrates are out of balance. The environmental situation has deteriorated, posing a great threat to human life. Poverty in the world is increasingly serious, the gap between wealth and the poor has increased. Natural resources are reduced and in deficit. (Kafadaoff & Douce, 2008). The question is asked how to meet the current needs of humans and ensure life for future generations. The answer comes from sustainable development. Sustainable development integrates environmental, economic and social factors. We must ensure the sustainable development of the environment of natural systems. Sustainable development is above all a process of economic development, balanced between ecology, economy and society (Kafadaoff & Douce, 2008). It respects natural resources and ecological balance. It ensures economic efficiency without affecting social efficiency, for example the process of combating poverty and inequality. Sustainable production practices function under the principle of minimizing pressure on natural resources with the help of appropriate management and preservation of biodiversity, decreasing the use of harmful consumables for the environment, and using polyculture and native varieties (FAO, 2015). Sustainable development is a concept that is defined as follows: "Development that meets the needs of the present without compromising the capacities of future generations to meet their" (Kafadaoff & Douce, 2008). In agriculture, farmers use a lot of chemical fertilizers and pesticides. These damage the soil structure and have also had damaging effects on toxicity, pollution of the environment, air and water. The development of sustainable agriculture is a very important process, it is a concept which is defined as follows: "Sustainable agriculture can be defined by the application to agriculture of the principles of Sustainable Development. It is therefore a matter of promoting economically viable, socially responsible and ecologically sound agriculture." (Kafadaoff & Douce, 2008). Sustainable agriculture is a system of food production. It meets the food needs of humans and livestock. In this area, man uses non-toxic energy sources. It must renew energies and restore natural resources. Sustainable agriculture does not destroy the natural environment. It protects ecosystems and restores degraded ecosystems. In the field of sustainable agriculture, humans must build production systems adapted to each ecosystem, to each different region. They can use production techniques adapted to the natural (climate, land, etc.), economic and societal situations of each region.

3.5.1. The place of permaculture into sustainable farming system

Among ecological alternative agriculture, initiatives grouped under the label “permaculture” are increasingly popular (Ferguson and Lovell, 2014). By relating ecological, agroecological and social problems, permaculture highlights the need to re-design society (Pezrès, 2010; Pignier, 2017) organically (Smith, 2015: 3) and starting with the food system (Mollison and Holmgren, 1978). In its very terms “permanent agriculture” it displays a double divergence from the dominant agricultural model. On the one hand, it is intended to be permanent in the sense of sustainable or ecological, because it does not destroy soils and ecosystems and does not depend on fossil fuels. Permaculture has indeed emerged following the first observations of an oil scarcity, climate change, and more generally the increasing attacks of the current economic model on the natural and human environment (Holmgren, 2002). Its permanence, on the other hand, refers to the sustainability of crops, integrating, like a border between meadow and forest, an association of crops of annuals, perennials and woody plants (Soltner, 1986). It is in this sense that permaculture does not only imply an evolution of agricultural practice, but a revolution in rural landscapes.

3.5.2. Previous research about sustainable farming in Morocco

Morocco is one of the many countries disproportionately affected by climate change in relation to the share to which it contributes. In fact, most of the countries of the South fall into this category. However, Morocco is spending far less funds on climate change adaptation projects, while forecasts for its future are rather bleak. The forecasts relate to rising temperatures, decreasing rainfall regularity, sea level rise and a feedback effect on forest cover and fish populations. Launched ahead of the COP22 organized in Morocco, the African Agriculture Adaptation Initiative (AAA) aims to reduce the vulnerability of Africa and its agriculture to climate change.

It promotes and encourages the establishment of concrete projects to improve soil management, agricultural water control, climate risk management and capacity building and financing solutions. Since its launch, the Green Morocco Plan has made sustainable agriculture one of its fundamental elements (Sajid, 2018). The Green Morocco Plan has made an ambitious investment, mobilizing 10 billion MAD annually for the benefit of the agricultural sector (Sajid, 2018). The objective is to ensure a rational use of water resources, phytosanitary products and also to deploy renewable energies on a massive scale. At the level of the first axis, it should be noted that agriculture consumes more than 80% of national water resources. In order to mitigate this overconsumption of water resources, it was necessary to develop water-saving techniques and equipment to properly control this rare commodity (Sajid, 2018). To this end, Morocco is making efforts to ensure better use of water for agricultural needs and to mitigate the effects of drought (Jaidani, 2020). The recommended techniques must be economically viable for the farms. Localized irrigation techniques, commonly called drip irrigation, are the most recommended in the case of Morocco. They have several advantages in terms of saving water, inputs and labor (Sajid, 2018). The mobilization of water resources necessarily requires a policy based on the construction of dams that the Kingdom has launched since its independence (Sajid, 2018). This proactive policy has made it possible to achieve the expected effects to support the development of town planning, industry and especially agriculture (Jaidani, 2020). Morocco currently has 145 dams with a storage capacity of 18.67 billion m3, 20 new dams are planned by 2027, and 14 more are already under construction which will increase the total capacity to over 27 billion m3 (Jaidani, 2020). Irrigated perimeters have grown to reach 1.6 million hectares (Jaidani, 2020). The rational and optimized use of phytosanitary products is the other battle that Morocco wants to win in the agricultural sector. The country wants to increase the volume of this type of input without having any impact on the environment. The average fertilizer units used nationally does not exceed 50 kg / ha, or nearly a third of the average fertilizer consumption in Spain or France (140 kg / ha) (FAO, 2015). This situation is due, in part, to the lack of supervision of operators (Jaidani, 2020).

In Morocco, cooperative projects occupy a significant place in the national economic fabric, it plays a predominant role in rural and sustainable development, insofar as it represents an important part in the economic and social development programs of the country. This field has opened up promising horizons to create economic and social development projects that work together to fight

poverty, exclusion, and the integration of small producers into the market. These horizons are reinforced by the National Human Development Initiative (INDH). “This has resulted in significant changes in both the workforce and the quality of cooperatives. This workforce increased from 5,749 to 9,046 cooperatives between the years 2007 and 2011, an increase of 57.35% during this period”.

3.6. Agricultural system in Morocco

3.6.1. Evolution of the agricultural sector in Morocco

Overall, since the 1990s, the open trade policy implemented by Morocco has aimed, particularly in the agricultural sector, to attract foreign investment and promote exports, while gradually liberalizing imports (Harbouze et al, 2021). In 2017, thanks to the development of its exports of agricultural products, the coverage rate of agricultural imports was greater than 100. Imports of agricultural products represented more than 12% of Morocco's total imports in 2017, or more than 5.3 billion euros. dollars and have increased by 26% since 2010 (Harbouze et al, 2021). With 1.7 billion dollars, the European Union remains the leading supplier of agricultural products to Morocco, it represents 33% of Moroccan imports of agricultural products, far ahead of Brazil, Argentina and the United States. Imports from the EU have grown 23% since 2010, with an annual average of USD 1.846 billion (Harbouze et al, 2021). Like the other southern Mediterranean countries, Morocco mainly imports cereals (wheat and to a lesser extent corn), for a bill estimated at nearly USD 1.3 billion in 2017, or more than 26% of its total agricultural imports, but also edible oils and sugar. Dependence on food imports has increased since 2001 (Harbouze et al, 2021).

In 2017, exports of agricultural products (including fishery products) represented more than 22% of Morocco's total exports, or nearly $ 5.57 billion. Moroccan agricultural exports have grown by 59% since 2010 (Harbouze et al, 2021). At $ 3.684 billion, the European Union is by far the leading market for Moroccan agricultural products. It represents 66% of Moroccan agricultural exports ahead of Russia, Turkey, the United States and Japan (FAO, 2015). Exports to the EU have grown continuously since 2001 and have increased by 62% since 2010. In 2017, Morocco exported 960,000 tones of vegetables worth $ 1.123 billion (FAO, 2015). These exports have been growing steadily since 2011. Morocco is the 14th largest exporter in the world and the first African exporter of vegetables, ahead of Egypt. It is now the world's leading exporter of green beans, with 125,000 tones sold in 2017, the world's 4th exporter of tomatoes (528,000 tones exported) and the 6th exporter of peppers (Faysse, 2015). In 2017, Morocco exported more than one million tones of fruit worth $ 917 million (FAO, 2015). These exports have increased by 46% in volume and 59% in value since 2010. Today, Morocco is the 8th largest citrus exporter in the world with 681,000 tones sold, including nearly 360,000 tones of clementine, which makes it the second largest supplier in the world behind Spain (Faysse, 2015). It is also one of the top ten exporters of small red fruits and in particular raspberries, products with high added value (Faysse, 2015). Last but not least, a fundamental characterization of farming in Morocco is its important fragmented arable lands in the kingdom, 108,000 farms with more than 3 ha, 660,000 farms with less than 1 ha, and 732,000 farms with between 1 ha and 3 ha irrigated (Moroccan Ministry of Agriculture and Maritime Fisheries, 2008).

3.6.2. Analysis of the Moroccan agricultural system

In 1996, agricultural land was distributed among 1.5 million holdings with an average size of 5.8 ha (Faysse, 2015). Landless farmers and very small farmers (with holdings of less than 3 ha), whose main resource is labor, still represented more than half of the holdings in Morocco (54%), held 12% of the UAA and 18% of the irrigated area (Faysse, 2015). The majority of these farms

practice subsistence agriculture are very vulnerable to drought and rely on the external income of the farm (Faysse, 2015). These operations are concentrated on marginal lands in the foothills and mountains, on the unfavorable bour and on the cleared lands of the steppe zones and in the oases. Moroccan agriculture is in fact divided between a modern industrial sector built around intensive agriculture which produces mainly food dedicated to exportations, and smallholdings that produce food for local markets and farmers' own subsistence (Faysse, 2015).

The majority of farms are too small to be able to mobilize the technical and financial resources necessary for agricultural intensification. However, given the importance of unfavorable rainfed in the UAA, the main constraint of Moroccan agriculture is the strong dependence on climatic hazards and in particular on very erratic rainfall.

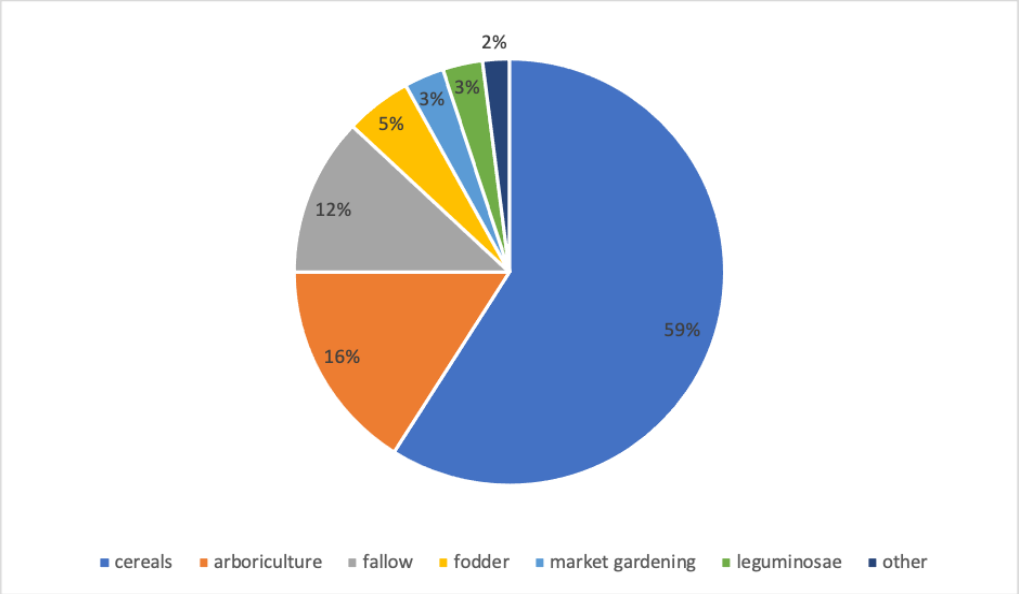


Figure 4. Distribution share of the utilized agricultural area (UAA) in Morocco by type of use. (Source: FAO, 2016)

4. DATA ANALYSIS & INTERPRETATION

In order to find answers to the object of this research, a survey was conducted over a sample of 31 participants, all permaculture farmers, thereby enabling the collection of primary data along with its interpretation and analysis. The questions for this survey were formulated in a way that it could draw a general profile illustration of participants (gender, age, property size, etc.), a socioeconomic background, and a preview of the costs of inputs (fertilizer, herbicide, pesticide) and origin of these inputs (bio, natural, chemical), in order to determine if permaculture brings enough means or could even improve smallholder farmers livelihood through the comprehension of their expense's management. The survey was shared on the Facebook group page of Permaculture in Morocco, and conducted in French, via Google Form platform, in order to not exclude the non-English speakers and multiply the chances of replies. However, the inconvenience with this process, looking for a population sample from a virtual support, keeps a vast majority of farmers aside, since smartphones, laptops, and internet are not necessary or easily within the reach of all farmers, either due to lack of means or due to illiteracy. Moreover, it is important to mention that only 35 percent of Moroccans speak French (Morocco World News, 2019), thereby the farmers speaking only Arabic find themselves excluded from this research; the pandemic didn't enable the research to reach farmers in a physical way because of movement restrictions. However, the Facebook group page of Permaculture in Morocco gathers a total of 3564 members, from which 31 filled out the survey. The portion is not considerable or makes it less reliable to draw conclusions, though, it provides participative information which could later support another research.

4.1. General illustration

The results collected in the Appendix 3 shows that, from the 31 participants for this survey, 77.4% are men and 22.6% are women. In other words, seeing that the survey was distributed to only permaculturists, it is observed that the place of women in an agricultural exploitation represents either ⅓ of the operational strength of a farm, or that possibly women occupy greater managerial responsibilities than what it could be thought but aren't recognized for the position they hold because of the preponderant role of men, in Morocco, in managerial tasks and decision making. For instance, a research from the FAO showed that in vegetable production, 25% of women took decisions in the absence of their husband, but still 75% deferred decision-making to their male sons (FAO, s.a).

Regarding the age group of the participants, it is registered that the 40-60 years old represent 41.9% of permaculturists who filled the survey, 32.3% concerns the 25-39 years old, and 25.8% are over 60 years old. These results show that the 18-24 years old are absent from the participation of this survey, which isn't surprising considering that farming is losing year after year attractiveness among the youngest adults.

The family situation of the permaculturists participants is presented as such: 56.7% are married with children, 26.7% are single, 13.3% are in a relationship (the ratio shown in the chart regarding the category of people with no children isn't to be considered due to a technical issue in the type of selection that was set for this question). In addition to this family scheme, it emerges from these results that 32.3% of the participants live currently in a household of 4 members, which represents the vast majority, as opposed to 16.1% living in a household of 2 members, also households of 3 members represent 16.1% of the participants, 12.9% live in a household of 5 members, 12.9% live in house of more than 5 members, and finally households of 1 member represent only 9.7%. These numbers could eventually illustrate the operational scheme of a small farm, and more specifically of a permaculture farm. Indeed, in small farms, operations are run by a family and rely mainly on family labor, both that of women and of men. Small farming requires a very inexpensive workforce

due to the lack of income and the difficulty to generate profit, therefore, this workforce is found in family members.

As it was stipulated in the theoretical foundation part, arable lands in Morocco are considerably fragmented, 108,000 farms with more than 3 ha, 660,000 farms with less than 1 ha, and 732,000 farms with between 1 ha and 3 ha irrigated (Moroccan Ministry of Agriculture and Maritime Fisheries, 2008). Actually, as it is illustrated in Appendix X, 38.7% of the participants own a farm of less than 1 ha, followed by 22.6% practicing on a land between 1-2 ha, 16.1% on a surface of 3-4 ha, 9.7% on a surface of more than 5 ha, the rest is split equally between properties within a range of 2-3 ha and 4-5 ha.

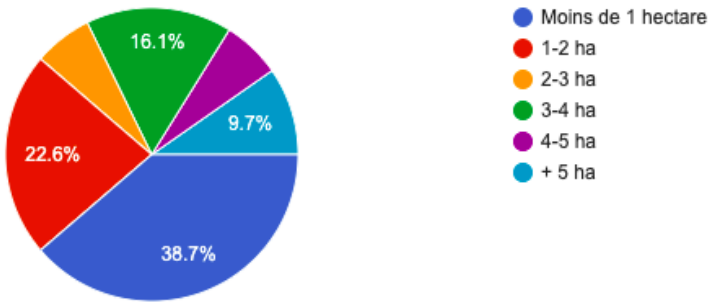


Figure 5: Pie-chart representation of property size among permaculturists in Morocco (See Appendix 3) (Question in English see Appendix 1)

Note: Moins de 1 hectare = Less than 1 hectare

Participants were asked how long they have been practicing permaculture in order to evaluate how many years of experience they have in this sector. The majority of them, 38.7%, have been maintaining a permaculture system between 2 and 4 years, 32.3% for more than 5 years, and finally 29% for less than 1 year.

4.2. Socioeconomic background

From all the permaculturists participants of this survey, 38.7% have a master's degree as their highest level of education, 32.3% have a professional license (which amounts to 2 years of higher education), 12.9% have a high school degree, and 6.5% have a bachelor's degree, the remaining have either no diploma, a Ph.D. or another kind of diploma not mentioned in the choice propositions.

Participants were asked to select the different items (laptop, car, home appliances, smartphone, tv), that themselves or one of the household members possesses. The results weren't surprising since first of all the survey was shared online, second of all, participants have for the majority of them a master, or at least graduated from high school. Which leads probably to the understanding that in fact the survey actually reached principally a population that is at least part of the middle class. Eventually, based on this context, 100% of them own a smartphone, 93.5% a laptop, 90.3% a TV, 96.8% own a car, and 87.1% possesses home appliances. The idea was to figure out if smallholder permacultures farmers own shopping goods. A shopping good is defined as a higher commodity, for instance, a car or a house, or electronics (Forsey, 2020). The analysis of smallholder farmers' means could have been more in depth if participants were also asked about their specialty goods purchasing, such as iPhone, which products are costly, but the consumer don't feel the need to compare and contrast because of its established brand in the opinion of consumers (Forsey, 2020).

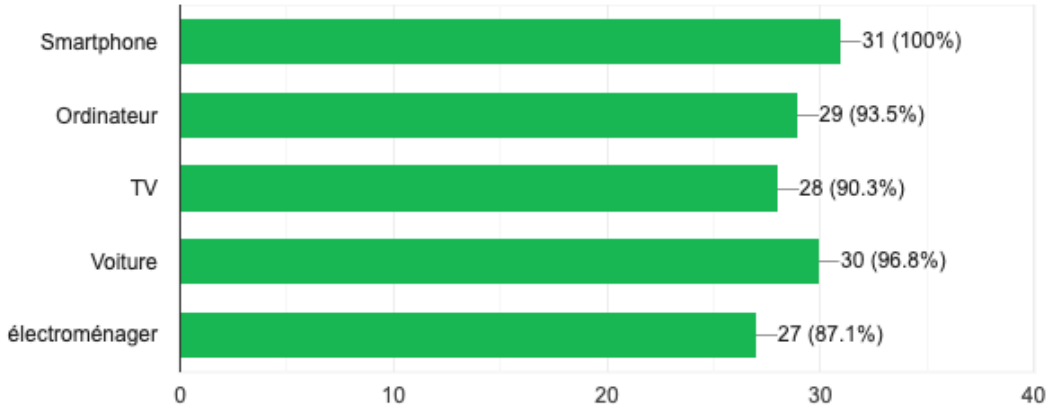


Figure 6: Percentage of participants owning certain items belonging to shopping goods and specialty goods, themselves or one of the household member (See Appendix 3) (Question in English see Appendix 1)

Note: Ordinateur = Laptop; Voiture = Car; Électroménager = Home appliance

As part of the process, the aim was to also collect information on how permaculturist perceive their level of lifestyle with this mode of farming. Thereby, it was accounted that 45.2% judge that they comfortably meet their primary needs, which are needs that are essential to life, such as food, water, clothing, and shelter. This number will be subsequently analyzed based on whether or not participants have another professional activity aside that contribute mostly or complement the net income perceived. In addition, 35.5% announce that they fairly manage to meet their primary needs, and 19.4% find it difficult. Considering these numbers, several possibilities could justify certain limitations of permaculture, since 19.4% testify on the difficulty of even meeting their primary needs, such as a lack of knowledge regarding the techniques to apply based on the soil and other factors.

Since the participants started practicing permaculture, 45.2% describe their lifestyle as “fair” or “correct”, while 38.7% designates it as good, 9.7% as poor, and 6.5% as very good. These numbers reflect a contrast that could encompass a series of reasons, from socioeconomic background to knowledge and production. In addition to this, among the participants, 40% affirms that in fact

permaculture enabled the improvement of their lifestyle, 30% affirms the opposite, and 30% are uncertain of this correlation.

It was then researched to measure the frequency of permacultures farmers traveling locally on one side, and abroad on the other side. This variable was chosen as a representation of secondary needs, which are needs that aren't fundamental for living but are essential for psychological well-being, in other words secondary needs are wants that come after primary needs are fulfilled. On this basis, the results have shown that 48.4% travel locally more than twice a year, in this case it concerns the Moroccan territory, 25.8% travel twice a year, 16.1% once a year, and 9.7% never travel locally in a year. The Figure 7 representing a pie-chart from the results of the survey correlates with these numbers given that traveling abroad induces higher costs so more means. In fact, 51.6% stipulate to never travel abroad in a year, 41.9% only once a year, and 6.5% twice a year.

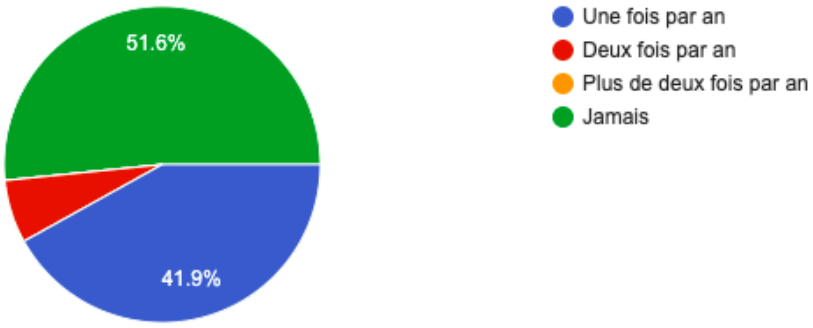


Figure 7: Percentage of participants traveling abroad (See Appendix 3) (Question in English see Appendix 1)

Note: Une fois par an = Once a year; Deux fois par an = Twice a year; Plus de deux fois par an = More than twice a year; Jamais = Never

One of the most important information collected concerns the fact of supporting itself on the sole basis of permaculture as a unique source of income. The numbers have proved that this correlation isn't as simple as it could be perceived because of the different personal objectives that smallholder farmers set up. For instance, an individual could wish to live a very simple life based on ecological

values, consuming essentially or/and only their harvested products, with few monetary means, and eventually taking the principle of "primary needs" as a need to survive to actually a want that is desired and providing pleasure and happiness to the household. And for this category principally the practice of permaculture represents a real activity as opposed to another category that would put permaculture into practice but essentially as a vegetable gardening. From the results, it is noted that 64.5% affirms to have another activity aside that allow them to benefit from a higher income, and 35.5% are only dedicated to permaculture farming.

4.3. Cost of production and income

Now moving to the accounting aspect of permaculturists farmers, involving the usage of machinery as well as inputs, including herbicides, pesticides and fertilizers, and the management of irrigation, given that they represent most of the production costs.

It has been registered from the results that 22.6% of the permaculturists, representing the majority, earn between 4500€ and 6600€ per year, considering that the minimum wage in Morocco is 300€ per months, which amounts to 3600€ per year (International Labour Organization, 2019). Following this wage range, 19.4% preferred not to answer, 19.4% earn between 8700€ and 10000€ per year, 16.1% earn between 6600€ and 8700€ yearly, 9.7% less than 3600€, 6.5% between 10000€ and 20000€ yearly, followed by 6.5% earning more than 20000€.

Regarding the production costs, machines induce certain costs from their purchasing to their maintenance, which greatly impacts small farmers' income. The results show that 38.7% own and use only 1 machine in their permaculture farm, 35.5% make no use of any type of machine, 19.4% have 2 machines, and 6.5% use more than 5 machines. Another interesting outcome of this survey is the average cost of inputs (pesticides, fertilizers, herbicides, insecticides) generated on a monthly basis. After computing the sum of inputs costs per person, the resulting average amounts to 37.8€

per month because of the ecological approach that uses natural components from simple animal and compost manure, or humacid manure based on lactobacillus as shared by the participants in this survey. Regarding the irrigation system employed in the participants' exploitation, we find rainwater harvesting and the drip system as the most used ones. A very small portion affirm to use the Keyline system, nothing at all for some, or another method not offered in the questionnaire. This indication illustrates these traditional methods which are in correlation with the permaculture principles and therefore do not engage considerable costs, besides for the drip instalment and eventually the source of water used. Finally, regarding the inputs. Last but not least, the source of pesticides, herbicides, and fertilizers used in the permaculturists participants' explorations are essentially bio-based (in other words natural, since in the questionnaire the two terms have been distinguished, which is in fact not the case after analysis). Another method that is engaged by permaculturists is the simple use of zero pesticides, herbicides or fertilizers. The use of chemical inputs remains present but on a lower proportion (i.e., 3.2% among the participants).

If the primary motivations are shared by all permaculturists, the operational way of developing the farm can vary significantly. We perceive it through the results on questionnaire, highlighting the different techniques used for the irrigation system. Each structure adapts to its local context and develops its own strategy. We find among these contexts the socioeconomic background at first. Indeed, some permaculturists will give themselves to this type of agriculture for personal ends with the aim perhaps of living a peaceful life in contact with nature. This category of farmers are often holders of a higher academic degree and were or are still currently working in positions that allow them to enjoy at least a middle lifestyle. Certain variables lead to believe that the major part of the permaculturists in a global point of view, but also in the context of Morocco, still practice in a context of vegetable gardening is that from the results, it is noted that 64.5% affirms to have another activity aside that allows them to benefit from a higher income, and 35.5% are only dedicated to permaculture farming. However, we find among these permaculturists, in smaller numbers, farmers who for them permaculture represents their only source of income and therefore their only professional activity. As it has been stated, in small farms, operations are run by a family and rely mainly on family labor, both that of women and of men. Based on previous studies, small farming requires a very inexpensive workforce due to the lack of income and the difficulty to generate profit.

5. CONCLUSION

That being said, we understand why it is difficult to really “make a living from permaculture”. But if it has been understood that food production will soon have to undergo an energetic descent, then permaculture will be essential. It is therefore necessary that permaculture can progress now, and therefore that there are real farmer-permaculturists and not just gardeners-permaculturists. If permaculture today does not allow you to “make a living from its exploitation”, it can allow, little by little, more people to live, quite simply. In the so-called developed countries, there are still very few permaculturists who make a living from their passion, giving courses and conferences, writing articles and books. There must be a few thousand who have almost withdrawn from the world and live-in near self-sufficiency in remote areas. But to compensate for the financial handicap, it is understandable why many permaculturists find ways to subsidize their activity in one way or another. Through courses, conferences, books, or any other related or parallel profession.

Conventional agriculture is subsidized by the farmers who work hard and leave their health there; by the citizens who pay taxes for agricultural aid; by fossil resources which provide energy, fertilizers and phytosanitary products at low prices; by nature, and the soil that is depleted as mineral resources. Thus, an agrarian system that does without these subsidies (servitude, aid, inputs, degradation) starts with a major handicap. However, a permaculture system is supposed to reduce the amount of work required, is not a priori financially subsidized, does not use fossil fuels (except perhaps at the very beginning), and seeks to worsen the soil and restore the ecosystems. Certainly, permaculture practices are designed in such a way that they are meant to be helped by nature, at least after some time. But it is relying too much on the benevolence of Mother Nature to believe that even with practices that respect and care for her, she will be able to compensate for the initial quadruple handicap. Permaculture can only get out of this handicap when the subsidies granted to the current system cease the abandonment of agricultural activity by farmers (overwork,

poisoning and lack of buyers), the bankruptcy of public aid programs, the reduction of agricultural subsidies, energy shortages, and rising fossil fuel prices.

When a landscape is managed with the principles of permaculture, the goal is to commercially export the surpluses (if only to neighbors), and not only to have a fairly productive and fairly stable system in a garden that operates according to farmer desires. The permaculture design provides methodology and ideas on how to arrange the landscape and the elements so that they interact, so that one's waste is food for another, that nothing is ever lost, etc. But in reality, everyone must adapt these ideas to their field and their context, this requires devoting significant efforts to the difficult and long development of the ideas resulting from the design phase, with probably many setbacks and disillusions. Thus, it is up to everyone to plan in their design a development period that could take a good ten years, especially when we are not thinking about a monoculture, but we must be in focus on all productions and the relationships between them in the farm landscape.

Permaculture is a development approach which aims for a certain efficiency, and which envisages a new paradigm of society. The notion of profitability, in any case financial, is linked to a market system in which it is part, and it is this very system that is the benchmark within which we will be able to judge the profitability of a thing. However, what permaculture offers is precisely to get out of this system and consider a new paradigm.

While permaculture does not vary much from one end of the world to the other. In Morocco and most probably in the vast majority of developing countries and underdeveloped countries, and unless you have very favorable initial conditions (climate and soil suitable for production, no initial debt (land and buildings already acquired), marketing channels already in place, etc.), it seems difficult to generate sufficient income to support a family in permaculture. On the other hand, it is quite possible to feed this same family with permaculture practices. People who are currently taking up permaculture are generally motivated by enthusiasm and a long-term vision, a desire for a simpler life. and more independent, but in any case, not by financial profitability.

APPENDIXES

Appendix 1. Questionnaire in translated in English (originally in French See Appendix 2) for permaculture farmers in Morocco.

Questionnaire for Permaculturists in Morocco

Hello to all the permaculturalists here in Morocco! Thank you very much for your participation in my questionnaire which aims to help me study the link between the application of permaculture and the standard of living of permaculture families, if indeed the latter would allow a family to live or not comfortably. * The information provided is intended to support my thesis (Master in Agri-Food Business Management with the Estonian University of Life Sciences). Thank you :)

* Required

1. Gender *

Mark only one oval.

- ◯ Women
- ◯ Men
- ◯ Other
- ◯ Prefer not to mention

2. Region *

Mark only one oval.

- ◯ Tanger – Tétouan
- ◯ Meknes - Fes
- ◯ Grand Casablanca - Rabat - Sale - Kenitra
- ◯ Souss Massa - Agadir - Marrakech
- ◯ Midelt

3. What is your age group? *

Mark only one oval.

- ◯ 18 - 24
- ◯ 25 - 39
- ◯ 40 - 60
- ◯ + 60

4. Family situation (multiple choice possible)

Check all that apply.

- ☐ Single
- ☐ In a relationship
- ☐ Maried
- ☐ With children
- ☐ No children

5. How many people live in your household? *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ + 5

6. Property size *

Mark only one oval.

- ◯ Less than 1ha
- ◯ 1-2 ha
- ◯ 2-3 ha
- ◯ 3-4 ha
- ◯ 4-5 ha
- ◯ + 5 ha

7. How long have you been practicing permaculture? *

Mark only one oval.

- ◯ Less than 1 year
- ◯ 2 - 4 years
- ◯ 5 years and more

8. What is your highest level of education? *

Mark only one oval.

- ◯ Less than a high school diploma
- ◯ High school diploma
- ◯ Professional license
- ◯ Bachelor
- ◯ Master
- ◯ Phd
- ◯ None

9. Do you or the people living in this house own any of the following items? *

Check all that apply.

- [ ] Smartphone
- [ ] Laptop
- [ ] TV
- [ ] Car
- [ ] Home appliances

10. Are you able to meet your basic needs? *

Mark only one oval.

- ◯ With difficulty
- ◯ Fairly
- ◯ Comfortably

11. How would you describe the type of standard of living you have maintained since practicing permaculture? *

Mark only one oval.

- ◯ Poor
- ◯ Correct
- ◯ Good
- ◯ Very good

12. Has Permaculture contributed to improving your standard of living? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

13. How often do you travel locally since doing permaculture? *

Mark only one oval.

- ◯ Once a year
- ◯ Twice a year
- ◯ More than 2 times per year
- ◯ Never

14. How often have you traveled abroad since doing permaculture? *

Mark only one oval.

- ◯ Once a year
- ◯ Twice a year
- ◯ More than 2 times per year
- ◯ Never

15. Is agriculture your only activity? *

Mark only one oval.

- ◯ Yes
- ◯ No

16. If not, can you clarify?

_____

17. Net income (annual) (Minimum wage in Morocco: 300€)

Mark only one oval.

- ◯ Less than 36000 €
- ◯ 3600 - 4500 €
- ◯ 4500 - 6600 €
- ◯ 6600 - 8700 €
- ◯ 8700 - 10000 €
- ◯ 10000 - 20000 €
- ◯ + 20000 €
- ◯ Prefer not to answer

18. How much agricultural equipment (machines) do you deploy? *

Mark only one oval.

- ◯ 1 machine
- ◯ 2 - 4 machines
- ◯ More than 5 machines
- ◯ None

19. On average, how much do you spend on inputs (only pesticides, fertilizers, herbicides, insecticides) on a monthly basis

_____

20. Irrigation *

Check all that apply.

- ☐ Rainwater harvesting
- ☐ Keyline system
- ☐ Drip
- ☐ Nothing
- ☐ Other

21. Use of fertilizers *

Check all that apply.

- [ ] Bio
- [ ] Natural
- [ ] Chemical
- [ ] None
- [ ] Other

22. Use of pesticides *

Check all that apply.

- [ ] Bio
- [ ] Natural
- [ ] Chemical
- [ ] Nothing
- [ ] Other

23. Use of herbicides *

Check all that apply.

- [ ] Bio
- [ ] Natural
- [ ] Chemical
- [ ] Nothing
- [ ] Other

Appendix 2. Questionnaire in French for permaculture farmers in Morocco.

Questionnaire pour les Permaculteurs au Maroc

Salut à tous les permaculteurs ici present au Maroc ! Je vous remercie infiniment pour votre participation à mon questionnaire qui a pour but de m'aider à étudier le lien entre l'application de la permaculture et le niveau de vie des familles permaculteurs, si en effet cette dernière permettrait à une famille de vivre ou non confortablement. *Les informations communiquées ont pour objectif de soutenir mon mémoire (Master en Agri-Food Business Management avec the Estonian University of Life Sciences). Merci bien :)

* Required

1. Sexe *

Mark only one oval.

- ◯ Femme
- ◯ Homme
- ◯ Autre
- ◯ Préfère ne rien dire

2. Région *

Mark only one oval.

- ◯ Tanger – Tétouan
- ◯ Meknes - Fes
- ◯ Grand Casablanca - Rabat - Sale - Kenitra
- ◯ Souss Massa - Agadir - Marrakech
- ◯ Midelt

3. Quel est votre groupe d'âge? *

Mark only one oval.

- ◯ 18 - 24
- ◯ 25 - 39
- ◯ 40 - 60
- ◯ + 60

4. Situation familiale (choix multiples possible)

Check all that apply.

- ☐ Celibataire
- ☐ En couple
- ☐ Marié(e)
- ☐ Avec enfant(s)
- ☐ Sans enfant(s)

5. Combien de personnes vivent dans votre ménage? *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ + 5

6. Taille de la propriété *

Mark only one oval.

- ◯ Moins de 1 hectare
- ◯ 1-2 ha
- ◯ 2-3 ha
- ◯ 3-4 ha
- ◯ 4-5 ha
- ◯ + 5 ha

7. Commercialisez vous vos productions issues de la permaculture? *

Mark only one oval.

- ◯ Oui
- ◯ Non

8. Depuis combien de temps pratiquez-vous la permaculture? *

Mark only one oval.

- ◯ Moins de 1 an
- ◯ 2 - 4 ans
- ◯ 5 ans et plus

9. Quel est votre plus haut niveau d'éducation ? *

Mark only one oval.

- ◯ Moins qu'un diplôme d'études secondaires
- ◯ Baccalauréat
- ◯ License professionnelle
- ◯ Bachelor
- ◯ Master
- ◯ Doctorat
- ◯ Aucun

10. Est-ce que vous ou les personnes vivant dans cette maison possédez les biens suivants? *

Check all that apply.

- ☐ Smartphone
- ☐ Ordinateur
- ☐ TV
- ☐ Voiture
- ☐ électroménager

11. Parvenez-vous à répondre à vos besoins de base? *

Mark only one oval.

- ◯ Difficilement
- ◯ Équitablement
- ◯ Confortablement

12. Comment décririez-vous le type de niveau de vie que vous maintenez depuis que vous pratiquer la permaculture? *

Mark only one oval.

- ◯ Pauvre
- ◯ Correcte
- ◯ Bien
- ◯ Très bien

13. Est ce que la Permaculture a contribué a l'amélioration de votre niveau de vie? *

Mark only one oval.

- ◯ Oui
- ◯ Non
- ◯ Peut-être

14. À quelle fréquence voyagez-vous localement depuis que vous faites de la permaculture? *

Mark only one oval.

- ◯ Une fois par an
- ◯ Deux fois par an
- ◯ Plus de deux fois par an
- ◯ Jamais

15. À quelle fréquence voyagez-vous à l'étranger depuis que vous faites de la permaculture? *

Mark only one oval.

- ◯ Une fois par an
- ◯ Deux fois par an
- ◯ Plus de deux fois par an
- ◯ Jamais

16. L'agriculture est-elle votre seule activité? *

Mark only one oval.

- ◯ Oui
- ◯ Non

17. Si non, pouvez-vous préciser?

_____

18. Revenu net (annuel)

Mark only one oval.

- ◯ Moins de 36000 Dhs
- ◯ 36000 - 45000 Dhs
- ◯ 45000 - 66000 Dhs
- ◯ 66000 - 87000 Dhs
- ◯ 87000 - 100,000 Dhs
- ◯ 100,000 - 200,000 Dhs
- ◯ + 200,000 Dhs
- ◯ Je préfère ne pas y répondre

19. Combien d'équipements agricoles (machines) déployez-vous? *

Mark only one oval.

- ◯ 1 machine
- ◯ 2 à 4 machines
- ◯ Plus de 5 machines
- ◯ Aucune

20. En moyenne, combien dépensez-vous en intrants (uniquement pesticides, engrais, herbicides, insecticides) sur une base mensuelle

_____

21. Irrigation *

Check all that apply.

- ☐ Récupération des eaux pluviales
- ☐ Système Keyline
- ☐ Goutte à goutte
- ☐ Rien
- ☐ Autre

22. Utilisation d'engrais *

Check all that apply.

- ☐ Bio
- ☐ Naturel
- ☐ Chimique
- ☐ Aucun
- ☐ Autre

Appendix 3. Results from the survey about permaculture farmers in Morocco.

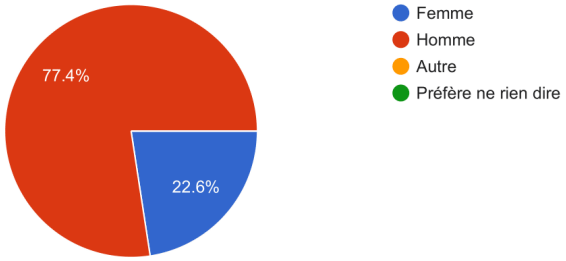
Questionnaire pour les Permaculteurs au Maroc

31 responses

Publish analytics

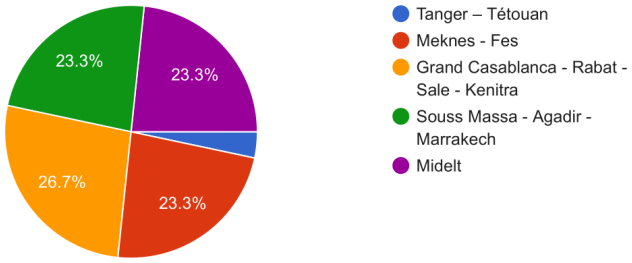
Sexe

31 responses



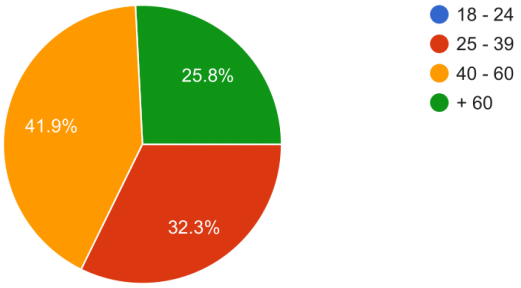
Région

30 responses



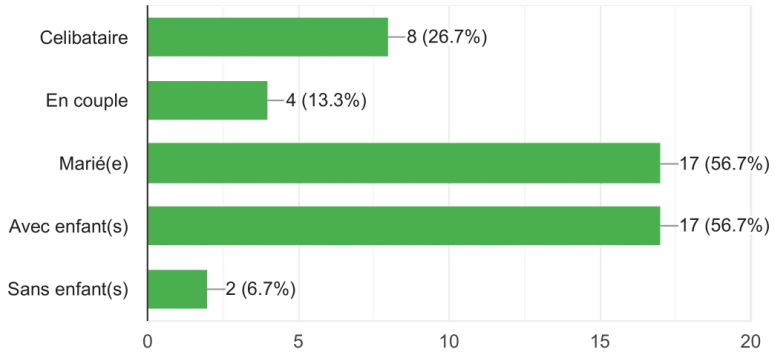
Quel est votre groupe d'âge?

31 responses



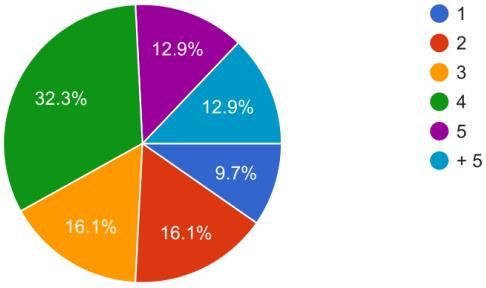
Situation familiale (choix multiples possible)

30 responses



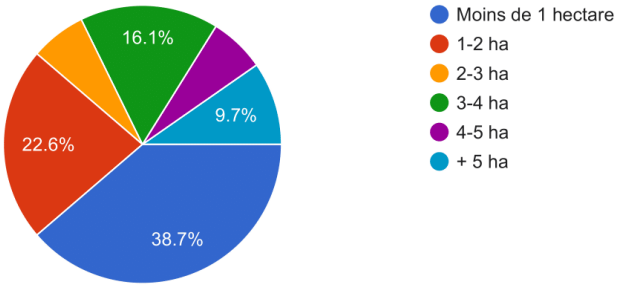
Combien de personnes vivent dans votre ménage?

31 responses



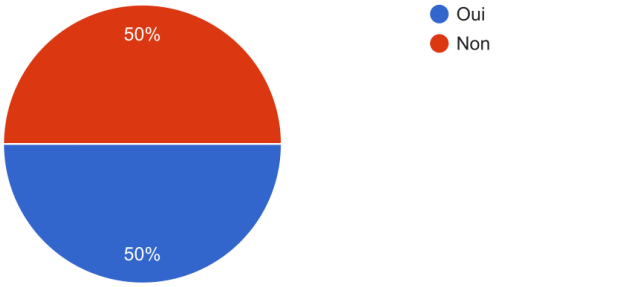
Taille de la propriété

31 responses



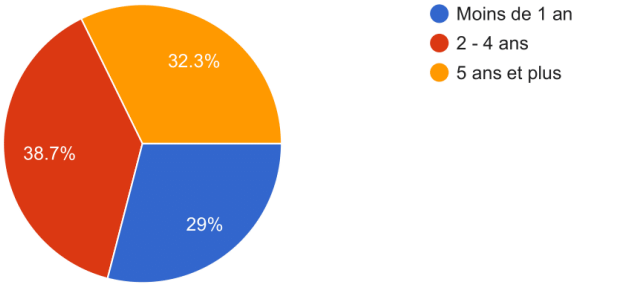
Commercialisez vous vos productions issues de la permaculture?

18 responses



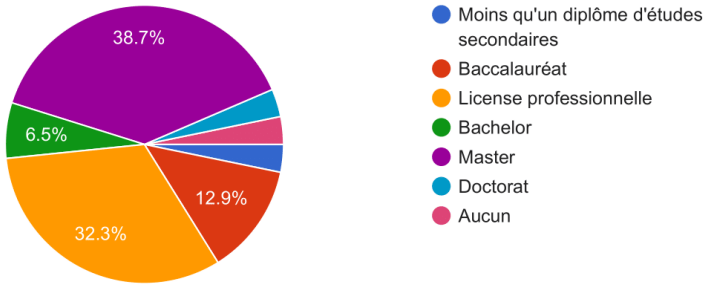
Depuis combien de temps pratiquez-vous la permaculture?

31 responses



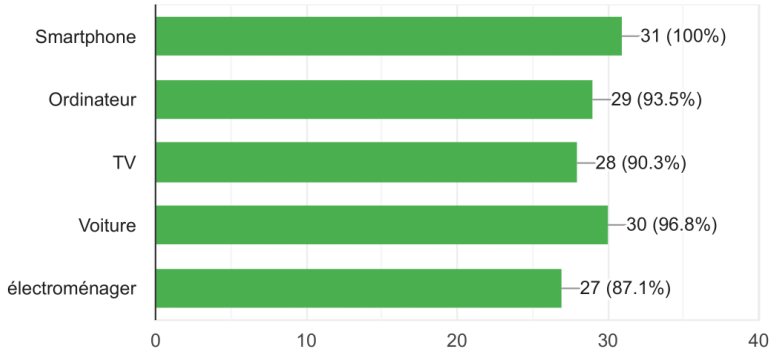
Quel est votre plus haut niveau d'éducation ?

31 responses



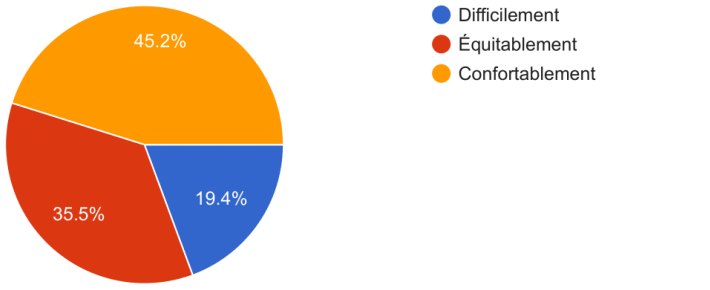
Est-ce que vous ou les personnes vivant dans cette maison possédez les biens suivants?

31 responses



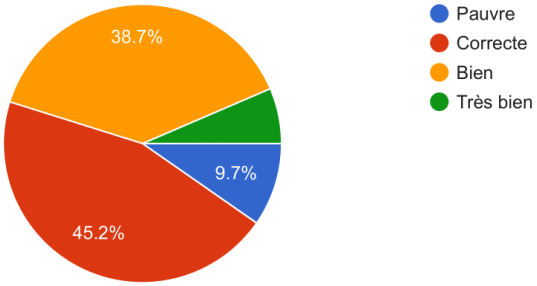
Parvenez-vous à répondre à vos besoins de base?

31 responses



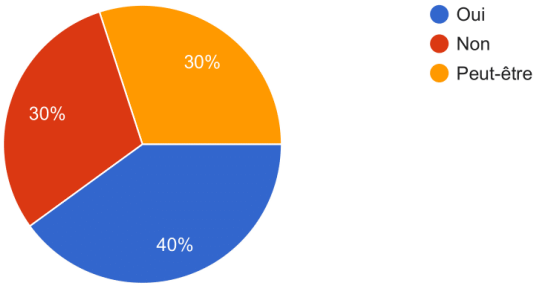
Comment décririez-vous le type de niveau de vie que vous maintenez depuis que vous pratiquer la permaculture?

31 responses



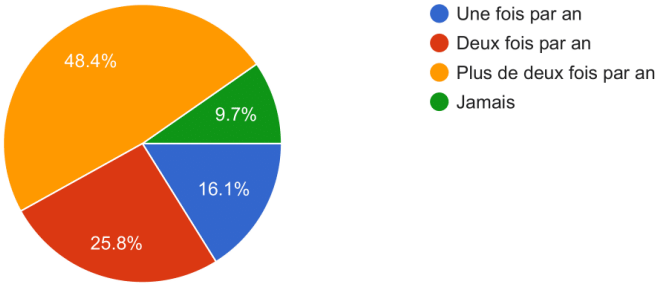
Est ce que la Permaculture a contribué a l'amélioration de votre niveau de vie?

30 responses



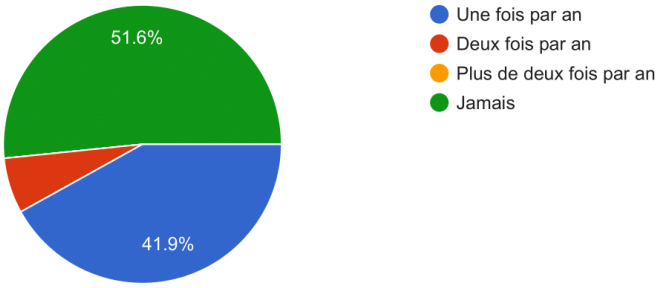
À quelle fréquence voyagez-vous localement depuis que vous faites de la permaculture?

31 responses



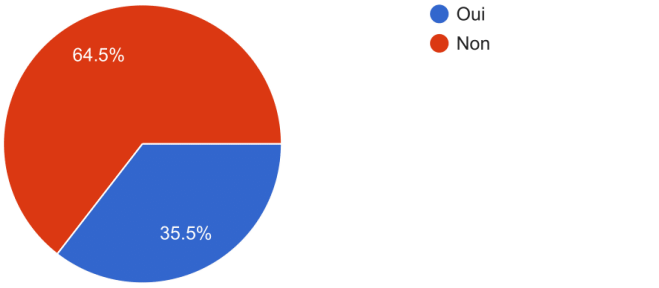
À quelle fréquence voyagez-vous à l'étranger depuis que vous faites de la permaculture?

31 responses



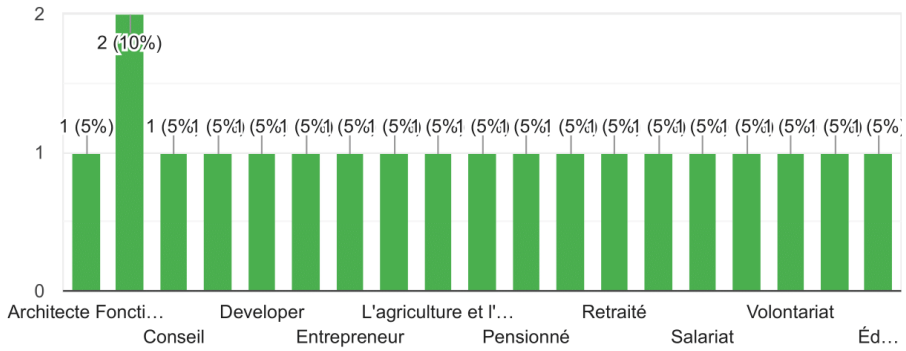
L'agriculture est-elle votre seule activité?

31 responses



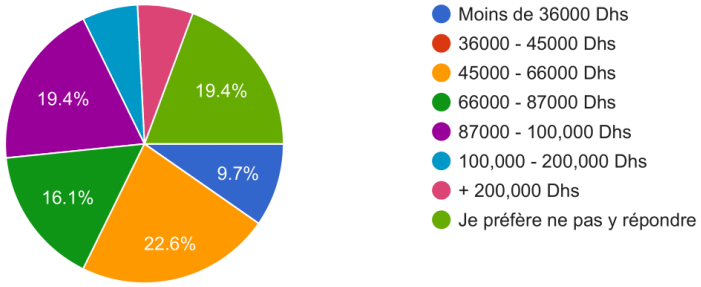
Si non, pouvez-vous préciser?

20 responses



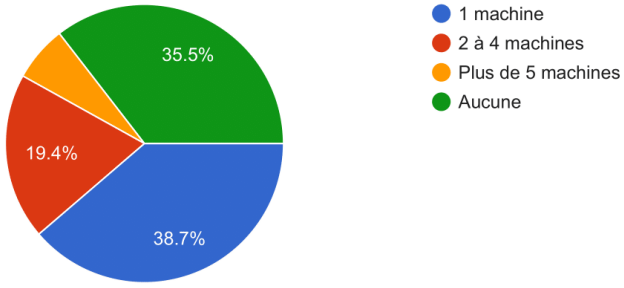
Revenu net (annuel)

31 responses



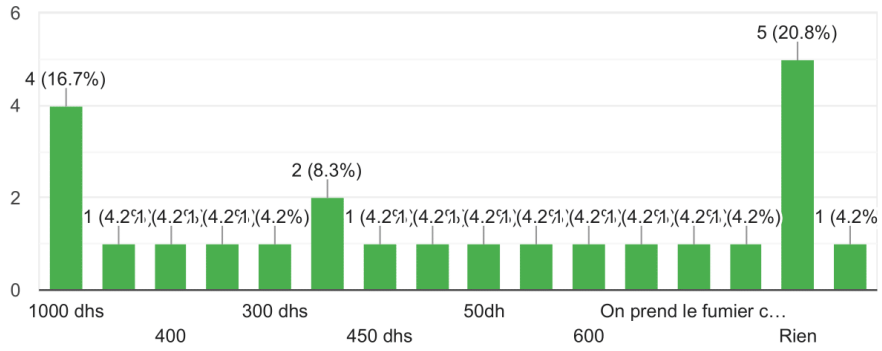
Combien d'équipements agricoles (machines) déployez-vous?

31 responses



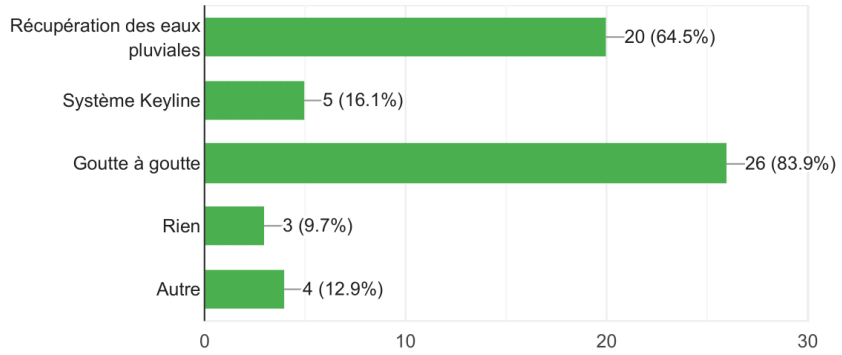
En moyenne, combien dépensez-vous en intrants (uniquement pesticides, engrais, herbicides, insecticides) sur une base mensuelle

24 responses



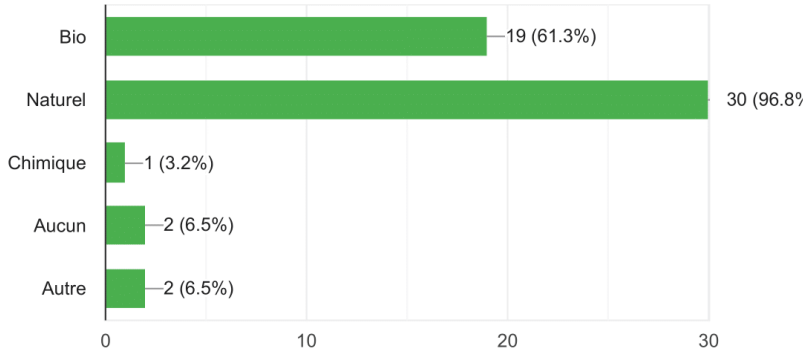
Irrigation

31 responses



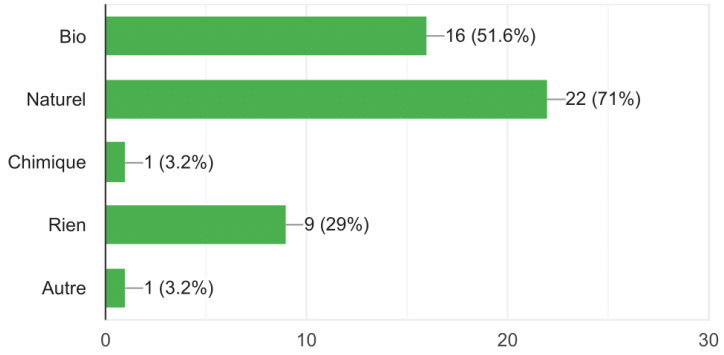
Utilisation d'engrais

31 responses



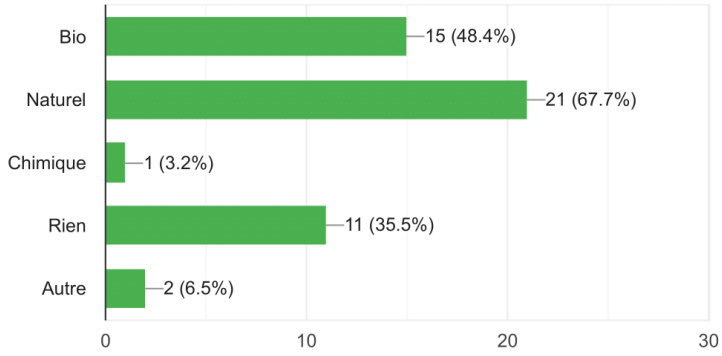
Utilisation de pesticides

31 responses



Utilisation d'herbicides

31 responses



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